the deflection of the galvanometer. Hence we would expect that the maximum current density would be set up in the earth's crust, most directly under the sun and parallel with the equator. Consequently the resultant of all of the current filaments set up in the earth's crust would be represented by Fig. 2, in which the currents in the southern hemisphere would be opposite to that in the northern.

As this current sheet advances westward with the sun, and its magnetic field strikes the various magnetometer needles, there will be the conditions for a westward deflection in the northern hemisphere and an eastward deflection in the southern hemisphere, followed later in the day by a reversed deflection in both cases.

This experiment on the mud strip was repeated and the same results obtained with several kinds of soil to be found here locally. The relation of direction of current and direction of motion of flame was the same for the mud strip as for the iron wire investigated by Tomlinson.[2] From what we know of thermo-electric elements, it would seem possible to find conditions where the direction of the current would be the same as the flame. For instance, in large areas covered by glacial deposits if one edge of the deposit was heated more than the opposite edge we might possibly find a condition as just stated. Certain it is that oceanic areas would differ from land areas for these thermo-electric earth currents.

It was interesting to note the effect of pouring water on the strip of mud. Fairly large disturbances were produced when one or the other edge of the wet portion was heated. Local showers might thus produce local magnetic disturbances.

Blowing air either on one side or the other of a heated section of the strip also produced regular disturbances. Winds in this respect may be a possible cause of magnetic disturbances.

The cooling effect of a cloud passing over the sun or the shadow of the moon sweeping across the earth's surface in an eclipse may be made manifest by setting up these thermo-electric currents which will affect the earth's magnetic field. The temperature to which the mud was heated was bearable to the hand.

Whether these thermo-electric currents actually exist in the earth's crust as due to the heat of the sun's rays, and whether they could be picked out from other earth currents, is a matter to be investigated further, but for the present it does seem worth while to learn more about these thermo-electric currents due to a moving heat source or sink in all sorts of conductors, particularly electrolytic.

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CHANGES OF DRAINAGE IN OHIO

THERE is probably no state in the union in which the advance of the ice caused more decided and interesting changes in drainage than Ohio. Almost every stream of any importance in the state is now running in a new channel for at least a part of its course, and most of them for practically their entire distance.

During the progress of the reconnaissance soil survey of Ohio the writer had an opportunity to visit every section of the state and to make some study of the adjustments in drainage which resulted from the advance of the ice. Some observations and conclusions are believed to be of general interest and may be of value in interpreting changes in drainage elsewhere.

The most important relates to the probable interglacial rather than preglacial origin of many old valleys in Ohio, but the gravelly nature of all terraces along streams in or issuing from the glaciated section of the state, as contrasted with the silt and clay character of the terraces along nonglacial streams, is also worthy of mention, as this fact often helps to determine the age as well as the direction of flow of some old streams.

The course of the old Kanawha River was definitely traced many years ago through the hills east of the Scioto in southern Ohio as far north as Waverly, but as to its further course there has been some doubt. The occurrence of deposits, similar to those in its old

channel, upon the west side of the Scioto northeastward from Waverly and the presence of an old valley extending on for several miles beyond Richmondale, carrying like material, and finally turning westward to the Scioto again below Chillicothe (see Waverly and Chillicothe topographic sheets) proves conclusively that the old Kanawha flowed northward as far as Chillicothe. It seems very probable that it also extended northward through the present Scioto Valley to the vicinity of Marion and then possibly on northward into Lake Erie.

It will be recalled by those familiar with the topography of Ohio that the highest point in the state is near Bellefontaine in Logan County. Although the rocks in this section dip to the southeast the hills east of Bellefontaine are capped with the same formations that are found around Delaware, although the latter is approximately 40 miles east and 600 feet lower in elevation. The large amount of erosion which has been necessary to the formation of the Scioto Valley would seem to indicate very strongly the continuance of the old Kanawha northward.

It has been shown by Tight[1] that an old valley leaves the Scioto about halfway between Columbus and Circleville and extends northeastward by Buckeye Lake and Newark to the Muskingum at Dresden. From this point the valley extends on northeastward up the Muskingum and Tuscarawas to Canal Dover and thence on northward by Beach City and Justus to Massillon. Beyond this point its course is rather difficult to determine because of the deep drift and possibly for other reasons which will be evident later.

This valley has been considered as a possible channel of the old Kanawha River although Leverett[2] states that he has "found decisive evidence against the suggested northeastward line, in the presence of an old divide now crossed by the Tuscarawas between Zoar and Canal Dover." He apparently rejects the northward extension of the old valley suggested above because of a restriction in width near Strasburg. However, the narrowest place is almost one half mile in width (about 2,300 feet), or wider than many places along the Ohio River to-day, and the restriction is believed to be due to the character of the rock. Almost as narrow a restriction occurs just north of Conesville (see Navarre, Canal Dover and Conesville topographic sheets). A rather careful study during last summer convinced the writer that the Tuscarawas from Navarre to Canal Dover was deflected by the Wisconsin glaciation and that the present course by Zoar and across the divide to Canal Dover was opened up during this time.

While the writer does not believe that this old valley was ever occupied by the Kanawha, this opinion is based upon other evidence than the presence of the divide near Canal Dover. It is believed that this old valley, as well as many others in Ohio, is of *interglacial* origin while the Kanawha is *preglacial*. Some of the reasons for this conclusion will be briefly presented.

From Chillicothe southward the Scioto River has a very much wider valley than the Hocking, Muskingum, or even the Ohio in much of its course. In fact these streams have practically no bottom lands. The Scioto Valley was evidently formed after the change in the Kanawha drainage because it is 100 feet or more lower than the old Kanawha Valley and therefore could not have been carved out by a northward flowing stream. It, therefore, becomes necessary to explain the greater width of this valley as compared with the valleys of the other streams. The most satisfactory explanation seems to be that during interglacial time this valley formed the line of discharge for all of the drainage northeastward, at least as far as the Tuscarawas drainage now extends, and it may be possible that the first change in the Ohio drainage was also across the divide between Canton and Alliance and down this valley. The elevation here, with the drift added, is hardly equal to that of the hills near New Martinsville and, if the advance of the ice, which first obstructed the northward Ohio drainage, did not come as

[1] *Bull. Dennison University,* Vol. VIII., Pt. II., 1894, pp. 35–61.

[2] Mon. 41, U. S. Geol. Survey, p. 103.

far south as Alliance, which seems very probable, the Ohio might easily have first broken over here and have flowed westward.[3] The deep drift in this section makes it difficult to determine this point but the width of the Tuscarawas Valley, the narrowness of the present Ohio Valley and the occurrence of lacustrine deposits north of Alliance and mixed more or less with the drift in many parts of the Grand River Valley seem to strongly favor such an hypothesis.

It is generally believed by geologists that the preglacial divide of the Ohio drainage was near New Martinsville, West Virginia. A study of the direction of the streams along the Tuscarawas would seem to indicate that the preglacial divide along this stream was near Port Washington and that Big Stillwater, Conotton and Big Sandy Creeks flowed northwest, the former by Canal Dover along the present course of Sugar Creek reversed at least beyond Beach City. Whether this stream joined the other two near Justus or Navarre or flowed on northwest separately can not be stated definitely because of the drift and the changes brought about by the advance of the ice. Below Port Washington the drainage was probably westward into the Scioto Valley and old Kanawha system.

Upon the first advance of the ice southward of Lake Erie the drainage of all northward flowing streams was obstructed and it became necessary for their waters to seek other outlets. As the country to the west was in general lower the streams were dammed up until they finally ran over the lowest divide on the west. There was a tendency for them to follow in a general way the ice border, just as the Ohio and Missouri Rivers to-day follow rather closely around the southern extension of the ice.

In view of the above considerations it is believed that the Tuscarawas-Scioto Valley had its origin in an early advance of the ice and represents the principal drainage line during interglacial time, and that the advance of the ice farther southward during the later glaciations forced the Hocking, Muskingum and possibly the Upper Ohio to change to their present channels. Such a hypothesis makes it possible to explain many very peculiar connections between old valleys, which are very difficult to understand otherwise. If the time which elapsed between the different advances of the ice, had been estimated with any degree of approximation it can be easily understood how much larger valleys may have been formed during interglacial periods than since. The matter appears to deserve more consideration in the interpretation of changes of drainage than it has been given heretofore.

GEORGE N. COFFEY

[3] Since this article was written the writer has had an opportunity to make further observations in the country north of Alliance and has found further evidence, particularly an old valley near Ravenna, to substantiate the hypothesis that the Ohio River first broke over in this section and formed the Tuscarawas-Scioto Valley.

THE POISONOUS NATURE OF THE STINGING HAIRS OF JATROPHA URENS

Jatropha urens is one of the most abundant Euphorbiaceous plants growing in or around the savannas of the Pacific coast of Central America. Its spread is favored by the fact that the cattle avoid it, and because it is not kept down by the too indolent owners of the pastures. Everywhere it has the reputation of being extremely dangerous, on account of its poisonous effects.

The plant is easily recognized: It is herbaceous, 0.5 to 1.5 meter high, regularly ramified, with large palmatilobate leaves, white flowers and small, 3-celled capsules. All parts, trunk, leaves, flowers and fruits are covered with long, hard and glossy, stinging hairs, which protect the plant as barbed wire protects the fortifications of to-day. It would seem as if the remarkable glossiness of the stinging hairs might warn the curious against approaching or touching. As a mater of fact, the animals either by instinct, or on account of the wisdom acquired through some previous experience, avoid contact with it.

The vernacular name of *Jatropha urens* is "ortiga" or "ortiga brava" (nettle) in Panama, and other parts of Central America, in-